REMARKS

Claims 10-15 have been cancelled. Claim 21 is new. The claims remaining in the application are 1-9 and 16-21.

Rejection Under 35 U.S.C. § 102

The Examiner has rejected claims 1-8, 10-14, and 16-20 under 35 U.S.C. 102(b) as being anticipated by Mead et al. (U.S. Patent No. 5,555,035). This rejection is respectfully traversed.

The Mead et al. reference cited by the Examiner is a system which uses a series of LCDs, or other type of spatial light modulator or display to form an image, using emitted light or light from some external source, not shown in the Mead et al. '035 disclosure. Light from the image thus formed is then relayed to photoactive LCDs 14, activating the photoactive LCDs 14 in order to form a second image that can then be projected. Referring to Figure 5 of Mead et al. it is seen that, in order to project each color (red, green, and blue) two imaging LCDs or other displays 12 are used to form the initial images, which are then relayed by relay lenses 13 to one or more photoactive LCDs 14. The image from the second set of LCDs is then projected onto a display screen. A separate projection lens 19 is then needed for each color, red, green, and blue. Figure 5 shows two tiled images projected for each color. Notably, the photoactive LCD 14 acts as a type of low pass filter for tiling an image that originates at the first bank of displays 12. In this way, an intermediate image, relayed from displays 12, is formed at the photoactive LCD 14 and is then suitable for projection. Illumination having only one polarization state is used at photoactive LCD 14; light having the orthogonal polarization state is discarded.

In contrast to the Mead et al. '035 apparatus, the apparatus of the present invention forms a tiled, multicolor image without the requirement for forming and relaying an intermediate image and provides the tiled image for projection from a single projection lens. No relay lenses are required for forming an image with the apparatus of the present invention. Unlike the apparatus of the Mead et al. '035 disclosure, the apparatus of the present invention utilizes polarized light having both first and second polarization, wherein the second polarization is orthogonal to the first. Moreover, where more than two tiles are desired, the approach used for the Mead et al. '035 apparatus requires that more

than one projection lens be used, even where a sequential RGB lighting scheme is employed. Thus, while the device of the Mead et al. '035 disclosure may have some rudimentary tiling capability, the cost, complexity, and constraints inherent to its design approach render such a solution both cumbersome and costly.

The Examiner has rejected claims 1-4, 6-13, and 15-20 under 35 U.S.C. 102(b) as being anticipated by O'Connor et al. (U.S. Patent Publication No. 2002/0191235). This rejection is respectfully traversed.

The O'Connor et al. reference, on first impression, appears to show an arrangement somewhat similar to the present invention. For example, unlike the device of the Mead et al. '035 disclosure discussed above, the apparatus of the O'Connor et al. '1235 application utilizes polarized light having orthogonal polarization states, as is shown in Figure 2. In the O'Connor et al. device, light of each polarization state goes to a separate light engine "kernel" for modulation. The modulated light from each kernel is then directed to a polarization combiner that superimposes or overlays the separate modulated beams for projection. Also unlike the device of the Mead et al. '035 disclosure, the O'Connor et al. device allows use of a single projection lens. However, the configuration shown and described with reference to Figure 2 in the O'Connor et al. disclosure does not perform tiling. The modulated beams from each spatial light modulator 34, 36, 52, and 50 are combined into a single beam at polarization combiner 12. The graphical notation of Figure 2 may visually suggest that there are three output beams: Green, Red, and Blue (Gr, Rr, Br). However, as the O'Connor disclosure clearly indicates, the modulated output beams are superimposed.

In contrast to the O'Connor et al. device shown in Figure 2, the apparatus of the present invention performs tiling within the path of modulated light, prior to the projection lens. As shown in Figure 1 of the present application, projection apparatus 10 actually directs the modulated light beam from each spatial light modulator 20a-20d along a separate path, parallel to the optical axis O of projection lens 18, such that the separate beams are substantially non-overlapping. Unlike the O'Connor et al. device, the apparatus of the present invention does not combine modulated beams having different polarization states. With reference to Figures 1, 3, and 4, for example, the present application explicitly states that beamsplitter 30 is not a polarization beamsplitter. Instead of

superimposing modulated beams having different polarization, beam aligner 40 directs each modulated beam along its own path to projection lens 18.

In the O'Connor et al. application, Figures 1-7 and 9-12 all illustrate a projection engine that superimposes modulated polarized light from two kernels A and B in order to form a single beam that is not tiled. Only Figure 8 and its accompanying description attempt to show a fairly limited solution for image tiling. Here, each of the two light engine kernels A and B outputs a modulated beam of polarized light that provides a tile for a display. It is instructive to note the significant limitations of the arrangement for tiling disclosed in Figure 8. Unlike the arrangements for superimposed modulated beams in Figures 1-7 and 9-12, which allow the use of a single projection lens, the component arrangement of Figure 8 would require two projection lenses, one for each tile. Attempting to use a single projection lens without some alignment mechanism in the optical path would result in a gap or other mismatch between the tile of the first display and the tile of the second. The polarization combiner, shown in Figures 1-7 and 9-12 and not shown in Figure 8, would not perform this alignment function with the arrangement shown. Recall that the polarization states from kernels A and B are orthogonal; the configuration of Figure 8 does not suggest how alignment suitable for tiling would be achieved with a polarization combiner. Moreover, the solution of Figure 8 is limited to a tiled display having only two tiles; there is no solution given for projecting an image with more than two tiles in the O'Connor et al. disclosure.

In contrast to the O'Connor et al. apparatus, the apparatus of the present invention provides parallel alignment of modulated output beams to perform tiling of two or more tiles using a single projection lens. For example, the arrangement shown in Figure 1 of the present invention forms a four-tiled display, with quadrants I, II, III, and IV as indicated. As is emphasized in the specification, the relative spatial positioning of spatial light modulators 20a-20d, as shown in Figure 2 of the present application, is important. This spatial positioning enables the non-overlapping arrangement of modulated light emitted from each of these components. Referring to Figures 1 and 2, two spatial light modulators 20a and 20b for quadrants I and II are positioned about polarization beamsplitter 22a such that the output modulated beam from each spatial light modulator 20a and 20b follows a separate path parallel to optical axis O.

Moreover, the pair of spatial light modulators 20a and 20b are vertically offset from the other pair of spatial light modulators 20c and 20d, which also direct light along separate paths. By contrast, neither Mead et al. nor O'Connor et al. disclosures describe or suggest any preferred spatial positioning arrangement of pairs of spatial light modulators.

The Examiner has rejected claims 1-4, 6-8, 10-13, and 16-20 under 35 U.S.C. 102(e) as being anticipated by Gibbon et al. (U.S. Patent Publication No. 2003/0063226). This rejection is respectfully traversed.

The Gibbon et al. disclosure describes a projector 100 that uses multiple spatial light modulators to provide a tiled display with improved resolution and overall image quality. In the Gibbon et al. apparatus, both superposition and tiling are employed. With reference to Figure 2, images from spatial light modulators 1a and 1b are relayed to a polarization beamsplitter 7 that superimposes them to form a single image having higher resolution; similarly, images from spatial light modulators 2a and 2b are relayed and superimposed to form a single image. The two resulting images are then relayed by relay lenses 9 to prism 10 or to an arrangement of mirrors that projects them in combination as a tiled image 12 having two tiles.

It is instructive to enumerate the significant differences between projector 100 of the Gibbon et al. disclosure and the projection apparatus of the present invention:

(i) Unlike the apparatus of the present invention, projector 100 of the Gibbon et al. disclosure provides a tiled arrangement that is constrained to a maximum of two tiles. The component arrangement described with reference to Figure 2 shows four spatial light modulators 1a, 1b, 2a, and 2b used for forming a two tiled display. There is no apparent way, disclosed or implied in the Gibbon et al. application, to increase the number of tiles that can be projected using this arrangement. Combining prism 10, or any equivalent arrangement of reflective surfaces providing the same function, would not be capable of providing a 2x2 tiled scheme, for example, such as the arrangement shown as tiled image 12 in Figure 1 of the present invention.

(ii) To support both superposition and tiling, projector 100 of the Gibbon et al. disclosure requires considerable optical complexity with a sizable number of components. For example, in order to form a single tile component of tiled image 12, this arrangement requires three polarization beamsplitters 6, 7, and 8, and three relay lenses 4, 5, and 9. The same number of polarization beamsplitters 6, 7, and 8, and relay lenses 4, 5, and 9, are needed to form the other tile component of tiled image 12. Certainly, the Gibbon et al. device would be significantly more expensive than the apparatus of the present invention. One skilled in the art would also appreciate the complexity needed for alignment of optical components within each modulated image path in implementing the Gibbon et al. solution.

(iii) There is no suggestion in the Gibbon et al. disclosure of any type of spatial offset for positioning spatial light modulators relative to the output optical axis in order to achieve non-overlapping beams, as is described with reference to Figures 1 and 2 of the present application. Instead, the requirement for superposition of images and use of relay lenses 4 and 5 in each superimposed image path clearly shows a deliberately tiny offset, in a fraction of a pixel distance, that merely provides enhanced resolution within the single, composite beam that is formed.

In summary, while there are necessarily some superficial similarities common to all projection apparatus utilizing multiple spatial light modulators, the apparatus of the present invention provides a novel solution for forming a tiled image. Unlike the solutions of the Mead et al. and O'Connor et al. disclosures, the apparatus of the present invention projects a tiled image having two or more tiles using a single projection lens. Unlike the solutions of the O'Connor et al. and Gibbons et al. disclosures, the apparatus of the present invention can form its tiled image as a composite of more than two individual tiles. Unlike any of the Mead et al., O'Connor et al., or Gibbon et al. solutions, the apparatus of the present invention employs spatial offset of individual spatial

light modulators relative to combining optics, so that the respective paths of modulated beams for each individual image tile are directed along the optical axis of the single projection lens in a substantially non-overlapping manner.

CONCLUSION

Dependent claims not specifically addressed add additional limitations to the independent claims, which have been distinguished from the prior art and are therefore also patentable.

In conclusion, none of the prior art cited by the Examiner discloses the limitations of the claims of the present invention, either individually or in combination. Therefore, it is believed that the claims are allowable.

If the Examiner is of the opinion that additional modifications to the claims are necessary to place the application in condition for allowance, she is invited to contact Applicant's attorney at the number listed below for a telephone interview and Examiner's amendment.

Respectfully submitted,

Attorney for Applicant(s)
Registration No. 29,134

Nelson A. Blish/tmp
Rochester, NY 14650
Telephone: 585-588-2720
Facsimile: 585-477-4646